CHAPTER 9 WETLAND ECOSYSTEM PRESERVATION PLAN COMPONENT(5)

9.1 Basic Policy

The natural environment in the Patos and Mirim lake vicinity is significantly characterized by extensive wetlands with natural vegetation peculiar to the area alone, even in Brazil. Peixe Lake is registered in the Ramsar Convention as an important transit site for migratory birds. There are also many highly biologically diverse wetlands that are worth preserving. Unfortunately, however, no organization is established and no budget is appropriated for the preservation of these natural resources, as administrators and state residents are not aware of their significance. As a result, there are fears that these highly environmentally sensitive wetlands and their ecosystem will disappear. Given these conditions, the basic policies for the wetland ecosystem conservation plan are established as follows:

(1) Promote Understanding of the Value of Wetlands

The administrators' ability to explain and the teachers'/professors' capability to extend guidance will be improved in order to make residents and other parties concerned understand wetland functions and the significance of wetland preservation.

(2) Organize a Wetland Committee

In order to promote wetland preservation, a wetland committee made up of representatives from relevant agencies will be organized to offer technical advise regarding planning, project implementation, and data collection.

(3) Preservation of Significant Wetlands and Facility Construction

Institutional protection will be provided especially for the 4 significant wetlands considered highly worth preserving, and an agreement will be entered with water users regarding water level maintenance. On one hand, access roads, and observation and

research facilities will be constructed to encourage many people to establish familiarity with the wetlands.

(4) Promote Wise Use of the Wetlands

Studies and research on the practical use of every wetland function, e.g. sewage treatment by using the purifying ability of wetlands, etc., will be encouraged.

(5) Collection and Making Public of Information on Wetland Ecosystem

Along with activities to promote research work for the restoration of Restinga, a shore vegetation peculiar to this area, information on wetland ecosystem will be collected with the cooperation of the NGO, and made public.

9.2 Measures to Promote Understanding of the Value of Wetlands

The following measures will be implemented to promote understanding of the value of wetlands.

1) A 10 year training period will be carried out for a total of 10,000 individuals [government employees (2,000), teachers/professors (6,000), interested parties and NGOs (2,000)] and bus tours will be arranged to visit wetlands. In addition, bus tours (2 to 3 day field visits) will be arranged for all 5^{th} graders (about 15,000 every year) in the Mar de Dentro area once the construction of access roads to significant wetlands, and observation and research facilities is completed.

2) Potential leaders (interpreters, facilitators, etc.) will be trained.

3) Hold an international convention on lakes and wetlands.

9.3 Measures for the Conservation of Significant Wetlands

1) Provide institutional protection, which includes zoning [state parks, preservation of aborigine areas, land use regulations (APA), private reserves (RPPN)], for the Camaqua riverine forest (**Fig. 9-1**), Del Rei wetland (**Fig. 9-2**), San Goncalo canal (**Fig. 9-3**), Pequena Lake (**Fig. 9-4**). Also, an agreement will be made with landowners concerning water intake for agricultural use as a means of controlling the water level, particularly the water level of the Del Rei wetland.

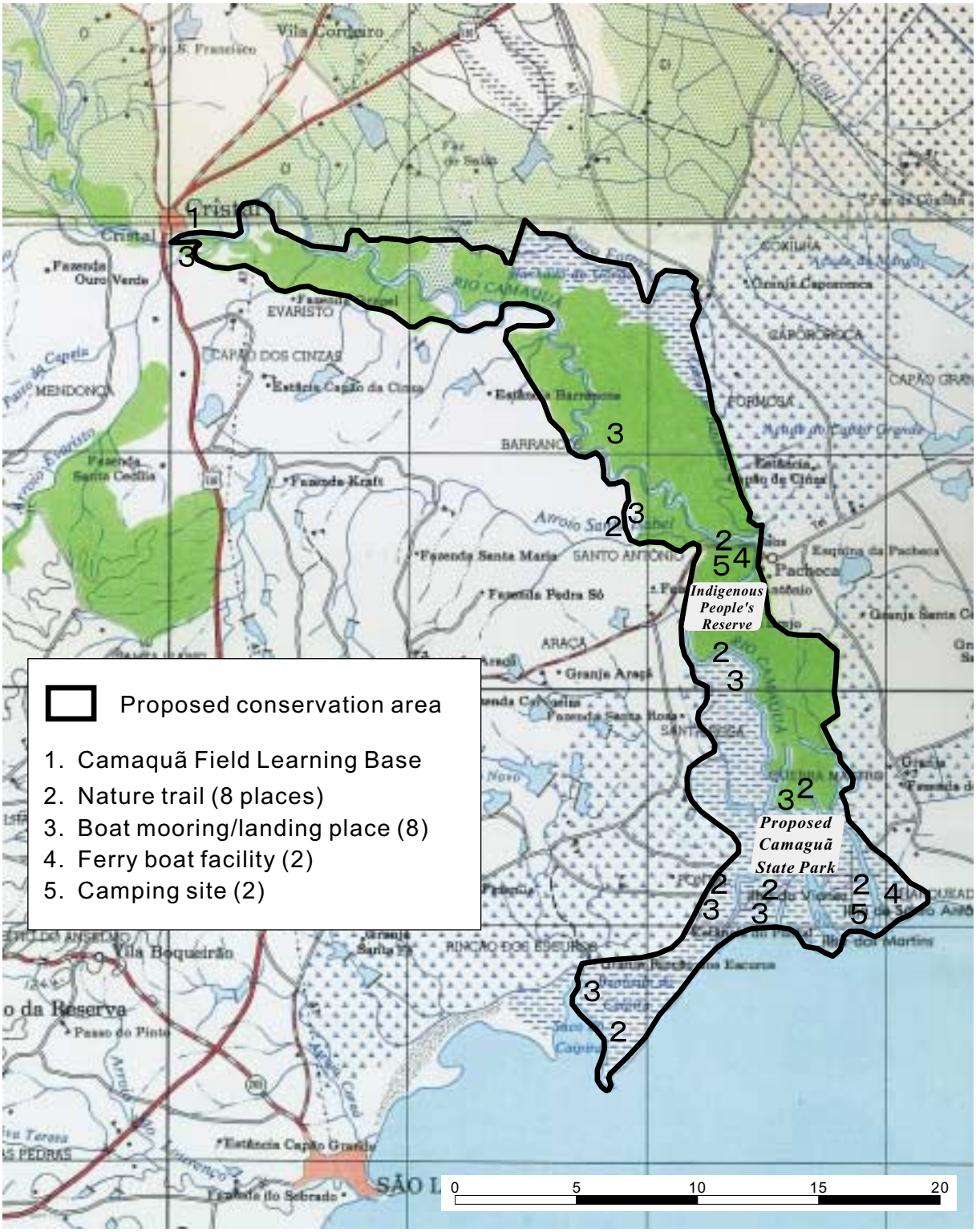
2) The facilities summarized in **Table 9-1** will be constructed to facilitate access and carry out effective monitoring and research activities.

3) Del Rei wetland should be registered in Ramsal Convention together with Taim of which IBAMA is in charge.

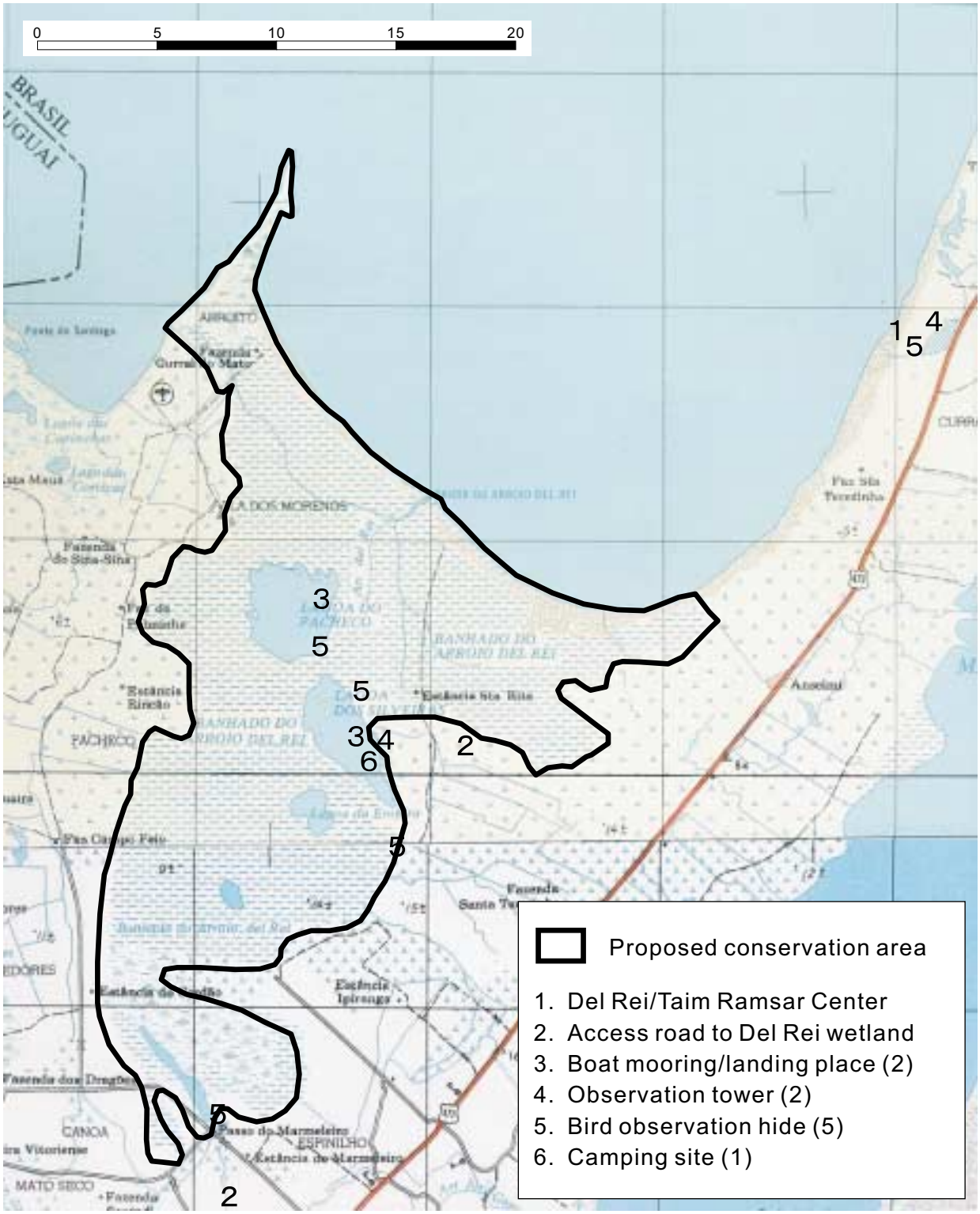
Table 9-1 Main Facilities for Significant Wetlands

Camaqua Riverine Forest ($235km^2$)	1) Base for actual learning experience in Camaqua (to be constructed outside of the park but near BR-116 for convenience) Functions: a. base for bus tours, b. wetland monitoring・database management, c. NGO support, c. observation of the protection of birds in forests
	2) Construction of access to the site by land and water, simple lodging and learning facilities (observation of living organisms in the water at the estuary, etc.)
	3) Acquisition of site for the state park
Del Rei Wetland ($360km^2$)	1) Del Rei/Taim Ramsar Center (to be constructed near the IBAMA office, along BR-471 as access to Del Rei is poor) Functions: a. foothold for observations in the Del Rei wetland, b. base for waterfowl observations, c. promote understanding of the Ramsar Convention
	1) Access roads to the Del Rey Wetland and access to the study site by water
San Goncalo Canal ($595km^2$)	1) Restinga Rehabilitation Center (to be constructed in the EMBRAPA RPPN wetland and the UFPEL permanent reserve forest nearby; due to the proximity, the cooperation of both agencies would be important and requested therefore). Functions: a. educational activities on forest and wetland flora, b. educational activities on livestock raising in low-lying wetlands for environmental preservation
Pequena Lake ($125km^2$)	1) Center for the Wise Use of Lakes and Wetlands (a small scale facility to be constructed at Z3, Pelotas) Functions: a. boat observation of the natural conditions in Pequena lake, b. learning how to use lakes and wetlands wisely through fisheries.

(Note): The following are existing facilities in the study area for the observation and study of various fauna and flora: Ecological Museum of the Federal University of Rio Grande, Sinos State Zoo, State Park in Itapua, Rami Municipal Park, National Park in Peixe. There is also an observation center for marine mammals at Ponta da Barra.



THE STUDY ON THE ENVIRONMENTAL MANAGEMENT OF THE HYDROGRAPHIC BASIN OF PATOS AND MIRIM LAKES IN THE FEDERATIVE REPUBLIC OF BRAZIL	**Fig. 9-1**
JAPAN INTERNATIONAL COOPERATION AGENCY KOKUSAI KOGYO CO., LTD. / PACIFIC CONSULTANTS INTERNATIONAL	**Proposed Area and Facilities for Camagua Riparian Forest Conservation**



THE STUDY ON THE ENVIRONMENTAL MANAGEMENT OF THE HYDROGRAPHIC BASIN OF PATOS AND MIRIM LAKES IN THE FEDERATIVE REPUBLIC OF BRAZIL

JAPAN INTERNATIONAL COOPERATION AGENCY
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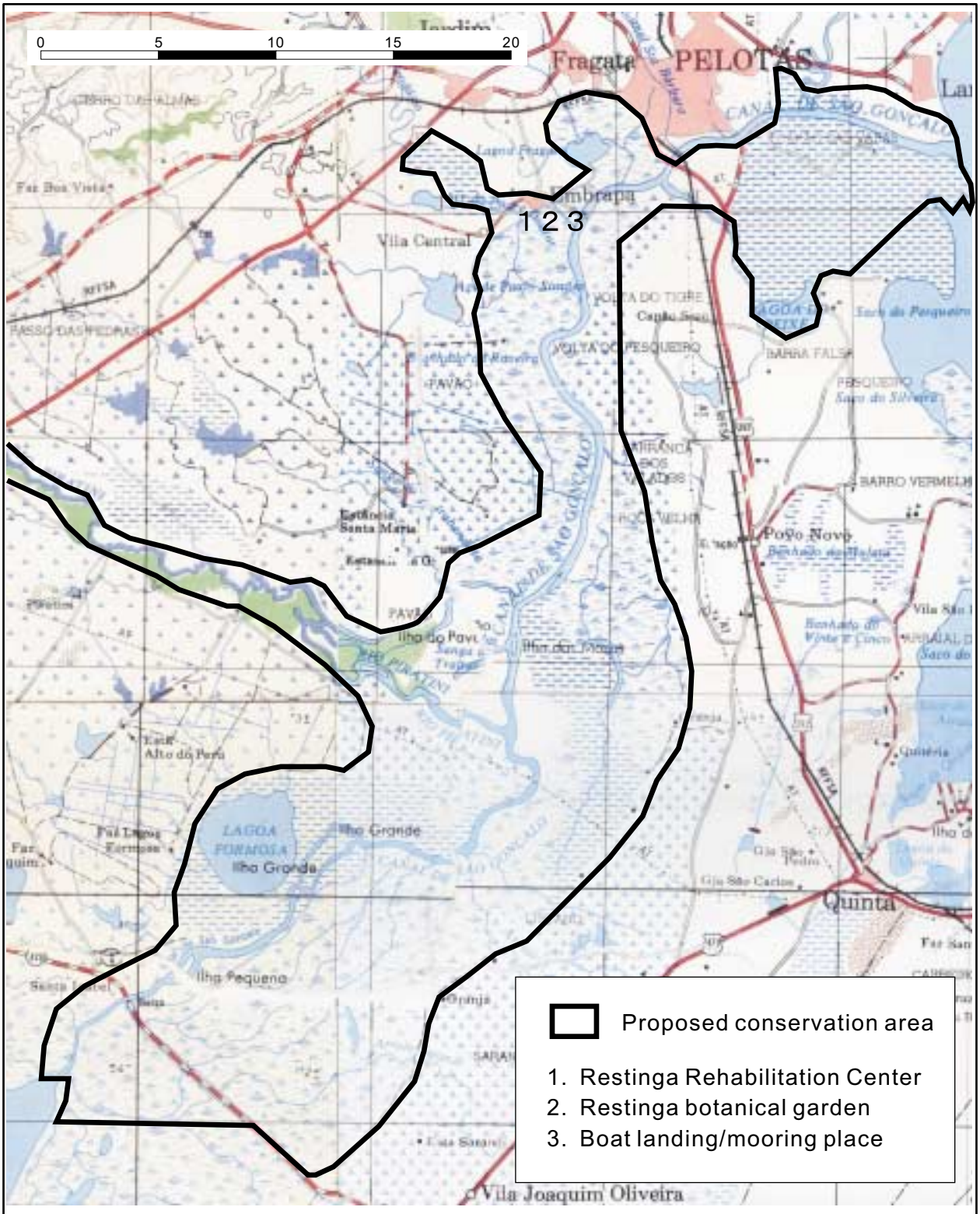
Fig. 9-2

Proposed Area and Facilities for Del Rei Wetland Conservation



THE STUDY ON THE ENVIRONMENTAL MANAGEMENT OF THE HYDROGRAPHIC BASIN OF PATOS AND MIRIM LAKES IN THE FEDERATIVE REPUBLIC OF BRAZIL	**Fig. 9-3**
JAPAN INTERNATIONAL COOPERATION AGENCY KOKUSAI KOGYO CO., LTD. / PACIFIC CONSULTANTS INTERNATIONAL	**Proposed Conservation Area and Facilities at Canal de Sao Goncalo**

THE STUDY ON THE ENVIRONMENTAL MANAGEMENT OF THE HYDROGRAPHIC BASIN OF PATOS AND MIRIM LAKES IN THE FEDERATIVE REPUBLIC OF BRAZIL	**Fig. 9-4**
JAPAN INTERNATIONAL COOPERATION AGENCY KOKUSAI KOGYO CO., LTD. / PACIFIC CONSULTANTS INTERNATIONAL	**Proposed Conservation Area and Facilities at Lagoa Pequena**

CHAPTER 10 WATER QUALITY AND HYDROLOGICAL MONITORING PLAN COMPONENT(6)

10.1 Basic Policy

Although water quality monitoring activities have been carried out in the past on some rivers, lakes, factories and enterprises in the Patos and Mirim lake basins, it is difficult to come up with proper countermeasures for present conditions due to the following: ① the activities neglect Patos Lake and the Mar de Dentro area and tend to focus on the Guaiba Lake and Guaiba basin, ② monitoring mainly focuses on contamination by human excreta by organic and harmful substances, and disregards eutrophication, ③ the level of contamination in rivers and wastewater did not take load (concentration + water volume) into consideration and was only based on concentration, ④ although Mirim Lake was monitored by the Mirim Lake Committee, which includes concerned parties in Uruguay, the flow and quality of rivers flowing into the lake were never monitored.

These problems and the environmental management system detailed in Chapter 3 were taken into consideration, therefore, in the formulation of the following basic policies for the monitoring of the water quality and hydrology of rivers, lakes, and pollution sources in the Mar de Dentro area.

(1) Monitoring activities within the budget limits

It is an accepted fact that monitoring should be continuously carried out for accurate results. Based on this concept, the number of monitoring stations and the items for analysis and measurements will be kept to the required minimum, and gradually increased in accordance with the budget. Further, the self-recording monitoring system will not be adopted as it is very expensive to operate and maintain.

(2) Monitoring System for a Changing Aquatic Environment

The aquatic environments of rivers and lakes covered in this study undergo great

seasonal and annual fluctuations. Therefore, as a rule monitoring will be carried out according to the seasons (4 times/year). The water environment also constantly changes with meteorological and hydrological conditions, hence measurements and sampling should be carried out, as much as possible, for a shorter period of time by a number of teams.

(3) Transfer of Monitoring Techniques to the Municipalities

The planning and supervision of monitoring activities are the responsibility of FEPAM. Due to staff shortage problems and the extensiveness of the study area, however, in-situ measurements and sampling activities are transferred to municipalities with monitoring stations. In this regard, a committee for the standardization of monitoring techniques will be established; the committee will prepare a monitoring manual and provide technical guidance.

(4) Phased Construction/Installation of Facilities and Machinery

Water quality analysis is divided between the state research institute and the university. However, for particular agro-chemical components, the work is entrusted to federal research institutes or universities where analytical instruments and techniques are already equipped. The state budget will be used to gradually provide state research institutes and universities the facilities and machinery they require.

(5) Making Monitoring Data Public

Data acquired from monitoring activities are placed by FEPAM in a database and is made available to relevant agencies, municipalities and NGOs whenever the need arises, through the internet network by creating its own homepage.

(6) Periodical Reconsideration of the Monitoring System

The monitoring system will be revised periodically as it is very important that it can effectively cope with changes in the use of the water areas, changes in contamination

levels and inflow load, as well as suitable observation and analysis equipment.

10.2 Patos Lake Monitoring System

Systematic monitoring activities have never been carried out in Patos Lake. Based on the above basic policies and the experiences gained from monitoring activities carried out in this study for a period of 1 year, it would be desirable to carry out future monitoring activities under the following specifications:

(1) Monitoring Items

The items to monitor in terms of water quality, bottom sediment quality, living organisms, meteorology and hydrology will be gradually increased in terms of priority, as shown in **Table 10-1**.

(2) Monitoring Station

The monitoring of water quality, bottom sediment quality and living organisms will be carried out from 22 stations (see **Fig. 10-1**), in consideration of the distribution of water quality, present use of water areas, and load inflow points in Patos Lake. However, in worse cases, monitoring will only be carried out from 9 of these stations. In addition, meteorological and hydrological monitoring activities will be continued from the existing 7 stations shown in **Fig. 10-1**, and carried out taking care not to result in any missing data.

(3) Monitoring Frequency

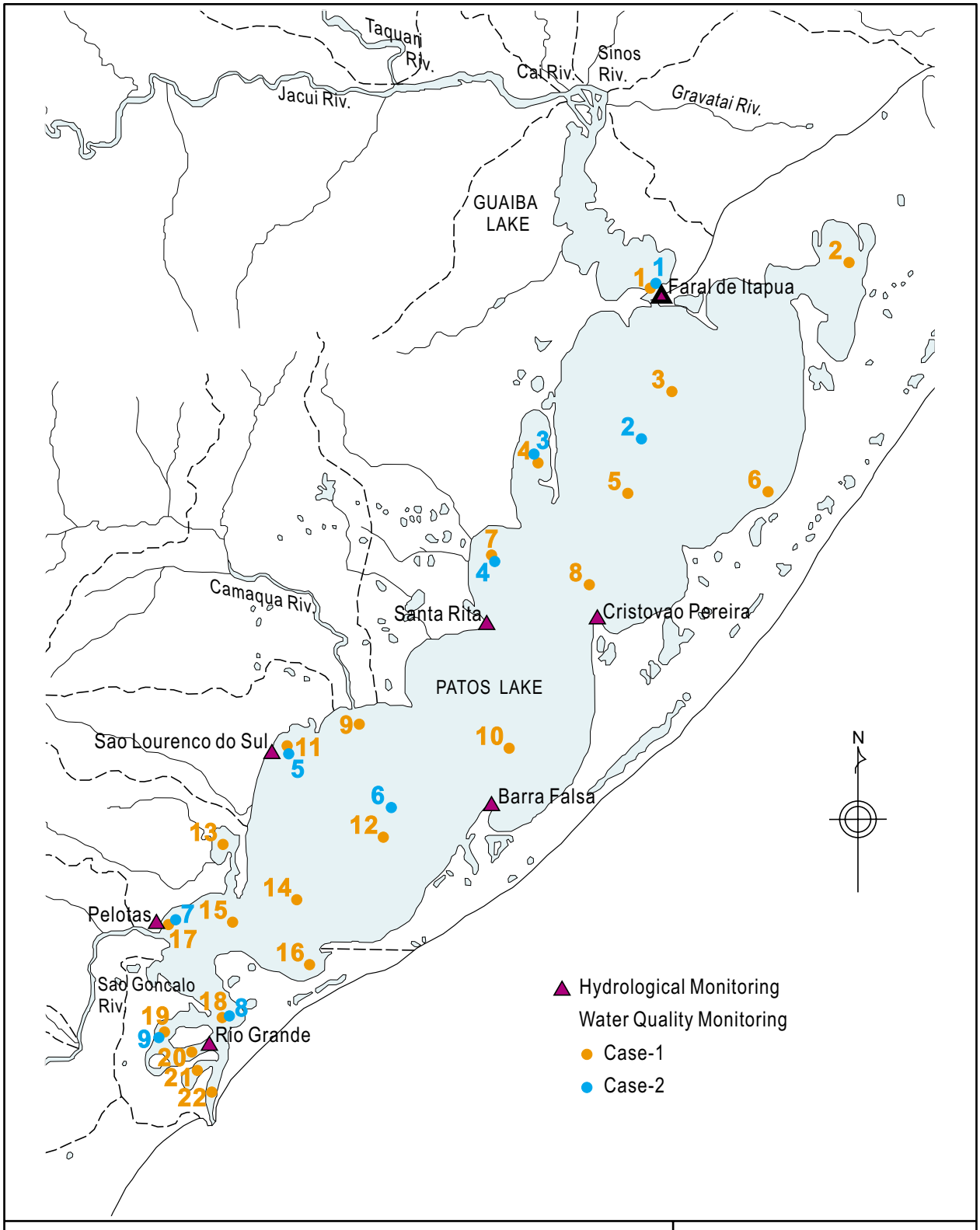
For basic water quality parameters, monitoring will be carried out 4 times a year. For other items, monitoring will be carried out once a year or once every 2 years depending on the priority ranking shown in **Table 10-1**.

(4) Monitoring Implementation System

The water areas for in-situ measurements and sampling for analysis will be divided among the municipalities. As much as possible, a number of teams will be organized to

Table 10-1 Prioritization of Monitoring Parameters

Priority	Monitoring Items	Parameters
A (High Priority)	Water Quality	Transparency, Color, Temperature, Salinity, pH, BOD, COD, DO, T-N, NH_4-N, NO_2-N, NO_3-N, T-P, PO_4-P, Chl-a, Coliform
	Meteorological and Hydrological Conditions	Temperature, Precipitation, Wind (velocity & direction), Water level
B	Water Quality	Odor, Oil Film, Floatage, Conductivity, Turbidity, T-S, Cd, Pb, Cr^{+6}, Cu, Ni, Zn, Hg, As, CN
	Bottom Materials	Color, Odor, pH, ORP, COD, T-S, T-N, T-P, Ig-loss
	Aquatic Lives	Biotic community, Phytoplanktons
C	Water Quality	Agricultural chemicals
	Bottom Materials	Cd, Pb, Cr^{+6}, Cu, Ni, Zn, Hg, As, CN, Agricultural chemicals
	Aquatic Lives	Benthos
	Meteorological and Hydrological Conditions	Amount of insolation



THE STUDY ON THE ENVIRONMENTAL MANAGEMENT OF THE HYDROGRAPHIC BASIN OF PATOS AND MIRIM LAKES IN THE FEDERATIVE REPUBLIC OF BRAZIL	**Fig. 10-1**
JAPAN INTERNATIONAL COOPERATION AGENCY KOKUSAI KOGYO CO., LTD. / PACIFIC CONSULTANTS INTERNATIONAL	**Proposed Monitoring Stations in Patos Lake**

implement monitoring for shorter periods (actual monitoring activities will be consigned to a local university and an NGO). The analysis of samples will be divided among FEPAM, FURG and CORSAN and this would require the unification of the methods to be employed for in-situ measurements, sampling, and analysis. Accordingly, the committee for the standardization of monitoring techniques will prepare a manual and provide technical guidance.

10.3 River Monitoring System

River monitoring has been carried out by FEPAM, CORSAN and DMAE based on differing objectives. However, since this study plans to carry out river monitoring for the preservation of the water quality of Patos Lake, the activities will be carried out based on the following specifications.

(1) Monitoring Items

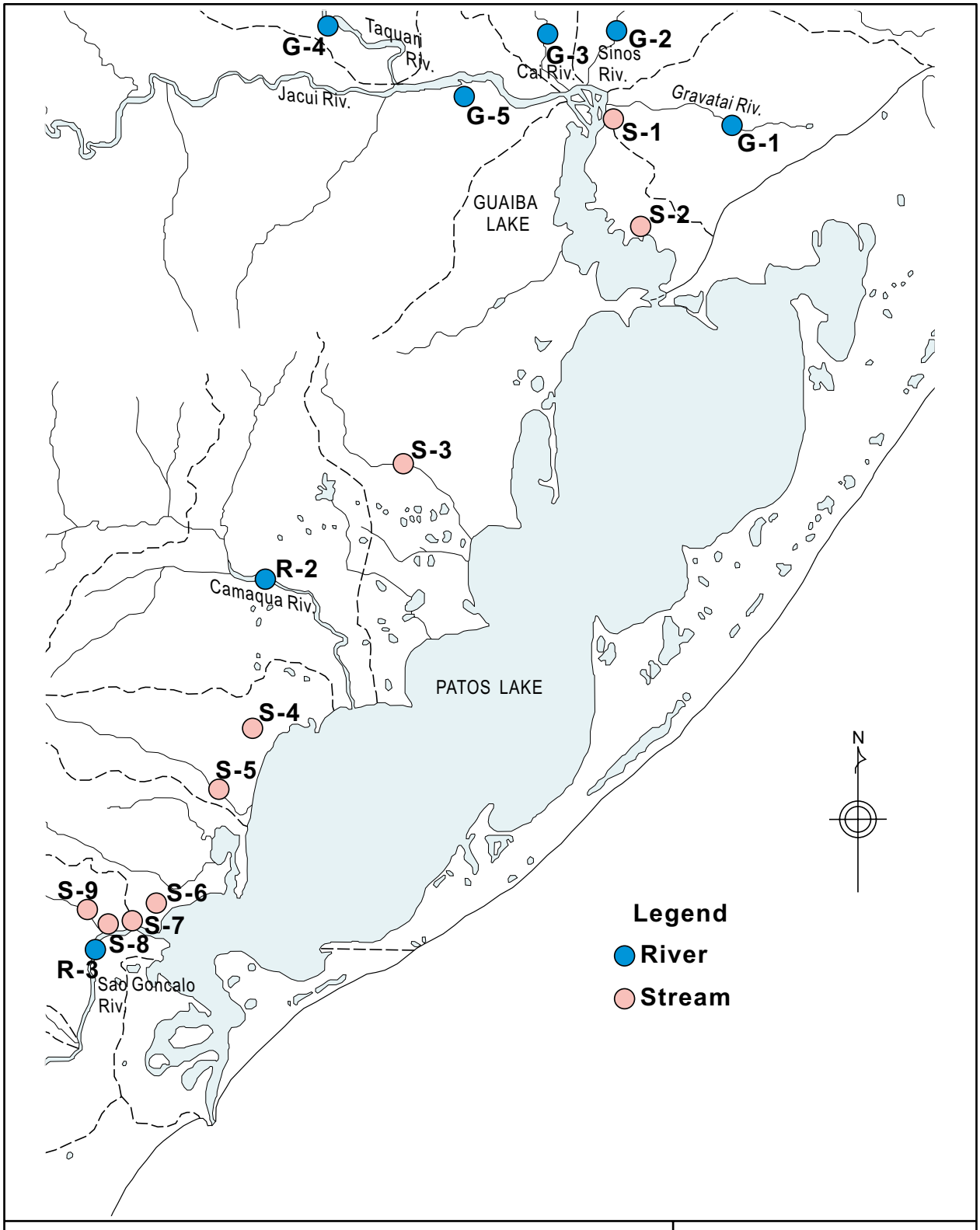
Discharge and water quality will be monitored and the parameters will be increased gradually according to the priority ranking indicated in **Table 10-1**.

(2) Monitoring Stations

Monitoring will be carried out at the 16 stations shown in **Fig. 10-2**. 7 of these stations are located in the downstream sections of 7 main rivers that significantly influence the water quality of Patos Lake. The other 9 stations are located in the downstream sections of small to medium sized rivers that affect the water quality at the coastal areas of the lake.

(3) Monitoring Frequency

Since the main rivers are large and subject to wide fluctuations in water volume, monitoring in the 7 stations will be carried out once a month. On the one hand, monitoring in the 9 stations will be carried out 4 times a year.



THE STUDY ON THE ENVIRONMENTAL MANAGEMENT OF THE HYDROGRAPHIC BASIN OF PATOS AND MIRIM LAKES IN THE FEDERATIVE REPUBLIC OF BRAZIL	**Fig. 10-2**
JAPAN INTERNATIONAL COOPERATION AGENCY KOKUSAI KOGYO CO., LTD. / PACIFIC CONSULTANTS INTERNATIONAL	**Proposed Monitoring Stations in Rivers**

(4) Monitoring Implementation Method

Discharge measurements and sampling for analysis will be consigned to the municipality (actual work will be consigned to the local university and NGO). The analysis of the samples will be divided among FEPAM, FURG and CORSAN and this would require the unification of the methods for water volume measurement, sampling and analysis. Accordingly, the committee for the standardization of monitoring techniques will prepare a manual and provide technical guidance.

10.4 Installation of Equipment for Monitoring and Analysis

The analysis of data acquired from monitoring is divided among the FEPAM (industrial wastewater), FURG (brackish water) and CORSAN (freshwater). Although these agencies have the required minimum equipment for analysis, the procurement of the additional equipment shown in **Table 10-2** is desirable in order to improve the accuracy and efficiency of the analysis work. For monitoring equipment, 20 sets of those shown in **Table 10-3** will be prepared. The committee for the standardization of monitoring techniques will manage these equipment and rent them out to the team in charge of in-situ measurements and sampling activities.

10.5 Monitoring of Wastewater from Factories and Enterprises

The monitoring of wastewater from factories and enterprises in the Guaiba River basin have been carried out, to a certain degree, by FEPAM. On the other hand, in the Mar de Dentro area, not only is wastewater not monitored but basic data such as the process for manufacturing goods, amount of water consumed, and wastewater treatment facilities, are unknown. Based on this, an inventory of the factories and enterprises in Rio Grande and Pelotas will first be prepared, followed by the selection of entities that would represent the types of factories and enterprises in the area, in order to carry out monitoring for the calculation of the effluent load per unit production.

Table 10-2 Analytical Equipment to be Supplemented

Objective	Equipment	Analytical item
for water analysis	Utermohl chamber with capacity of 5, 10, 50, 100ml	2 set, plankton count
	Sedgwich rafter chamber	3 set, plankton count
	Sebelin digester with 6 mouths	1 set, COD analysis
	Electronic heater of 300×400mm with 50-300C temperature regulator	2 sets, NH4-N, T-N analysis
	Water bath with 6 mouths	1 set, solid determination
	TOC auto-analyzer	1 set, total organic carbon
	Vacuum pump for water sample filtering	2 sets, Chl-a determination
	Fluorimeter	1 set Chl-a determination
	Radioactive scintillation counter	1 set, C14 measurement
	Spectrophotometer : UV- visible	1 set, PO4-P, NO2-N, NH4-N analysis
for sediment analysis	CHNS analyzer	1 set, C, N, S analysis in sediment
for heavy metal analysis	Spectrophotometer atomic absorption analyzer	1 set, heavy metal analysis
	Mercury analyzer with fluorescence detector/generator	1 set, Hg analysis
	Ion chromatograph system	1 set, Cr, CN determination
	Microwave oven digester	1 set, metal analysis in aquatic organisms

Table 10-3 Observation Equipment to be Supplemented

Observation Equipment	Number
1) Secchi disk	20
2) Salinometer	20
3) pH meter	20
4) Turbidity meter	20
5) Sampler for water	20
6) Sampler for bottom materials	20
7) Ropes, etc.	20

CHAPTER 11 ORGANIZATIONAL STRENGTHENING AND JOINT INFORMATION USE PLAN COMPONENT(7)

11.1 Basic Policy

For the preservation of the aquatic and wetland ecosystem, it is requested that the problems encountered by each state government sector should be dealt with by basin. In this regard, the agency that coordinates the sectors plays a major role. As project planning and implementation would require various information, a system that would efficiently utilize the information held by every sector is very essential. In consideration of the problems in the present environmental management system specified in Chapter 3, the basic policies for the organizational strengthening and joint information use plan are established as follows.

(1) Master Plan Implementation System

The executing secretariat for the Mar de Dentro Program (SEPMD) is established within the SCP of the state of Rio Grande do Sul. The department promotes the PRO-MAR program by establishing contacts with every sector, municipality, university and NGO. Three committees will be organized to provide SEPMD technical and financial assistance as well as assistance in policy making, in order to establish a strong implementation system.

(2) Strengthening of the SEPMD

SEPMD does not have the sufficient number of staff to efficiently cope with its designated functions. In view of this situation, more employees will be assigned to the department as a means of strengthening its functions.

(3) Strengthening of FEPAM

SEMA-FEPAM are mainly responsible for solving the environmental problems of the state. However, staff shortage makes it difficult for FEPAM to effectively carry out monitoring activities in the Mar de Dentro area which also brings about outstanding delays in licensing and approval services. To solve this particular situation, SEMA is considering transferring a part of the services to the municipality, eliminate functions that are unnecessary and strengthen those that are of importance.

(4) Promote Joint Use of Information

The type and whereabouts of information required for the implementation of the Master Plan, which are presently unknown, will be confirmed. A database will be constructed and a map will be produced, and both will be entered in the web site of every agency. In addition, SEPMD will also put the implementation process and relevant information on the web site to encourage the residents to trust the government, and foster a sense of responsibility among government employees.

11.2 Master Plan Implementation System

For the PRO-GUAIBA program, which covers the Guaiba River basin, the executing secretariat was organized within SCP. The department coordinates with the state government sectors and other relevant agencies and promotes a comprehensive environmental preservation project with funding from IDB. Using the PRO-GUAIBA implementation system as a reference, the master plan implementing system, with SEPMD as the executing secretariat, is as shown in **Fig. 11-1**.

SEPMD would need a staff of around 10 to carry its various functions described in **Table 11-1**. The following committees will also be established to support SEPMD: policy making committee, technical committee, financial committee.

To support the SEPMD, the following committees will be organized: policy making committee, technical committee, and financial committee. **Table 11-1** shows the functions of each committee and the responsible agencies.

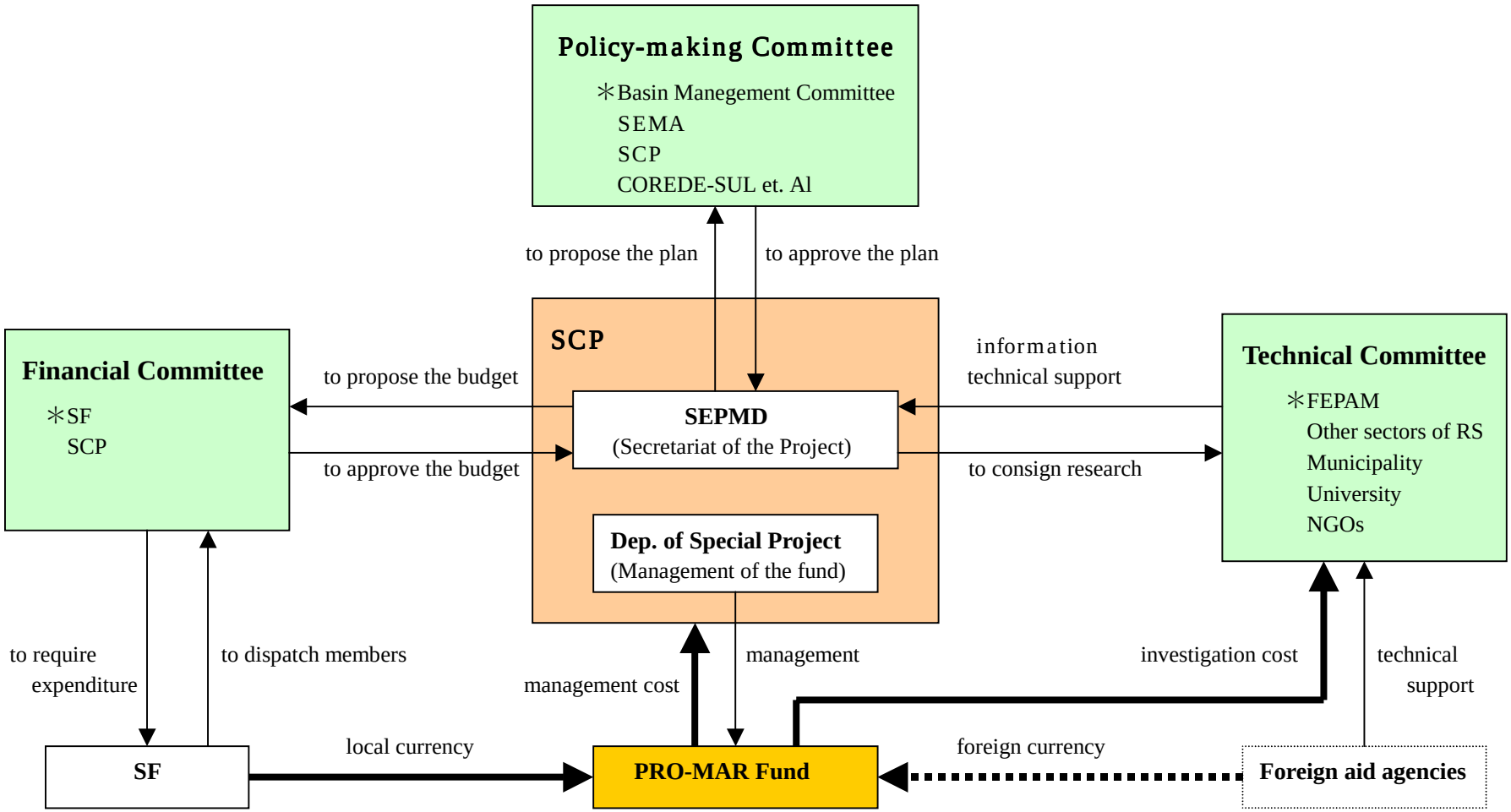


Fig. 11-1　Executing Organization of the Project

Table 11-1 Functions of the Mar de Dentro Program Executing Secretariat

Name (Responsible Agency)	Functions	Agency in Charge
Agency responsible for administrative work for the project (SEPMD/SCP)	Instructions to and coordination of relevant agencies	SEPMD/SCP
	Collection and management of information	
	Summary of environmental management plan	
	Summary of the project plan	
	Summary of legal amendments	
	Promotional campaigns, web site management	
	Summary of fund procurement and repayment plan	DSP/SCP
	Management and application of PRO-MAR funds	
Policy making committee (SEMA)	Decide the zoning of water areas and basin areas	Basin management committee (consist of representatives from government agencies, water users, and residents)
	Deciding the water area and land use plan	
	Deciding the environmental management plan	
	Deciding the project plan	
	Deciding the priority ranking for projects to implement	
	Deciding the fee collection system	
Technical committee (FEPAM)	Study the zoning of water areas and basin areas (draft)	FEPAM
	Study the aquatic environmental management plan (draft)	FEPAM
	Study the water resource management plan (draft)	DRH
	Study the wetland ecosystem management plan (draft)	Wetland committee (FEPAM, FZB, NGO, university)
	Sewage treatment techniques	CORSAN, SANEP, DMAE
	Solid waste management techniques	SANEP
	Monitoring techniques	Committee for the standardization of monitoring techniques (FEPAM, university, municipality, NGO)
	River and lake water quality monitoring	FEPAM, FURG, DMAE, university
	Monitoring of effluents of enterprises	FEPAM
	Environmental conservation oriented agriculture	EMATER, (EMBRAPA)
	River management	EMATER, DRM
	Database, GIS, and information processing	Database management committee
	Environmental education and personnel capacity building	SE, university, NGO
Financial committee (DSP/SCP)	Study the project scale	SF, SOPS, SCP
	Approval of the fund procurement and repayment plan	
	Request revenues from the state financial department	

The basin management committee has been appointed as the committee in charge of the formulation of policies for water resource management. However, for the implementation of the master plan, SEPMD will be responsible for the formulation of the policies. With the assistance of SEMA, SEPMD will prepare a draft and will explain the context to the basin management committee. The technical committee will provide SEPMD with technical advice and information, and even conduct studies when necessary. The wetland committee and the committee for the standardization of monitoring techniques proposed in Chapters 9 and 10 will be established as a part of the technical committee. With assistance from the Special Project Department of the SCP, the financial committee will conclude the appropriateness of the budget proposed by SEPMD. The money for the implementation of the priority projects will be pooled from the PRO-MAR funds, including foreign reserves, and will be managed by the Special Project Department of SCP.

11.3 System for the Joint Use of Information

The information required for the implementation of the master plan are summarized in **Table 11-2**. Although the whereabouts and details of these information have been partly confirmed through this study, many of the information are still unknown. Clarifying these points should be given priority.

As mentioned in Chapter 3, water quality data that has been monitored vary by agency in terms of parameters, monitoring frequency, and accuracy of results. These differences are considered inevitable as the agencies carry out the monitoring work under differing objectives. The data will be placed in a database in specific form and placed in the web site to allow mutual use; this will increase the rate of use of these data. The same can be said about the results of the monitoring activities of NGOs on living organisms, thereby increasing the possibility that these results will be reflected in the plans of government agencies.

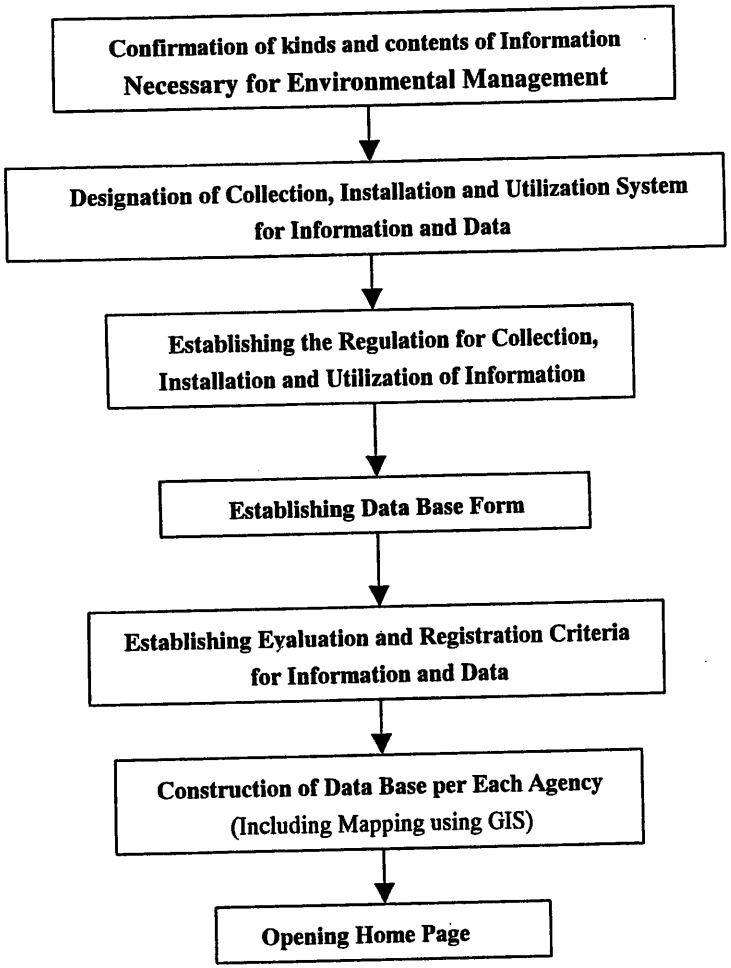
Producing a map containing some of the information would also prove to be convenient. The GIS using ArcInfo (ArcView) that had been introduced to the state is being used for the PRO-GUAIBA program. Utilizing this system for the master plan would eliminate the need for new investments for facilities and allow the accumulation of topographic/mapping information.

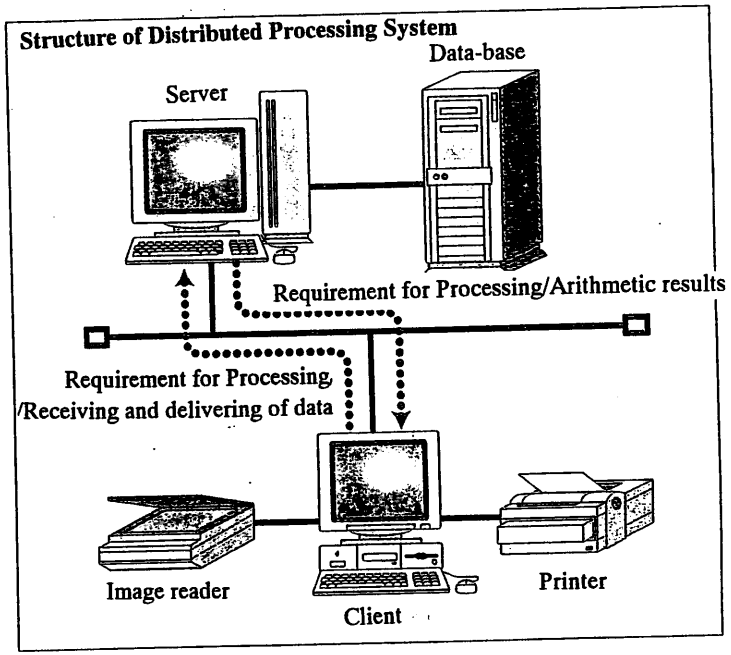
Fig. 11-2 shows the process for the construction of the system for the joint use of

information. This system will be a client/service oriented distribution processing system. A database will be constructed for the data of every sector of the state, municipality, university, and NGOs which will be arranged in a specified format and be made accessible through the network. Agreements regarding the database structure, construction and use will be decided by the database management committee to be organized within the technical committee.

Table 11-2 Information for Environmental Management and the Agency Responsible for Collection and Management

Major Category	Minor Category	Agency Responsible for Information Collection and Management
Mapping information	Topographic map	Ministerio do Exercito
	Slope classification map	(IBGE)
	Geological map	DNPN
	Soil distribution map	MA/EMBRAPA/CPACT
	Vegetation map	(IBGE)
	Land use map	(IBGE)
	Water use map	None
	Nautical chart	DEPRC, (DHN)
Remote sensing information	Satellite images (LANDSAT, SPOT, etc.)	CEPSRM
	Aerial photos	None
Statistics	Population	(IBGE)
	Statistics on water resources (water demand by use)	DRM
	Industrial statistics (production output by industry)	None
	Land use statistics (area by land category)	SAA
	Statistics on livestock raising (number of heads by type of livestock)	SAA, LARA
	Statistics on fisheries (catch by species)	SAA
	Agricultural statistics (cropping area, agro-chemical consumption, etc.)	SAA, EMATER
	Statistics on health and sanitation (water supply diffusion rate, sewerage diffusion rate, no. of patients with water-borne diseases)	
Facility Inventory (installation point, structure, functions, performance, cost)	Irrigation facilities (intake, drainage, dam, bay, etc.)	DRM
	Pollution source (industrial, public, etc.)	FEPAM
	Sewage treatment facility (puriying tank, sewage treatment plant, industrial wastewater treatment plant)	CORSAN
Inventory of living organisms	Bird species	FZB, NGO
	Wetland vegetation	FZB, NGO
Wetland inventory		JICA study results
Monitoring data	Meteorology (rainfall, wind conditions, temperature, evaporation, etc.)	INMET, DNAEE
	River flow	INMET
	River water quality and bottom sediment quality	INMET, CORSAN
	Water level (lake water level, tidal level)	IPH-UFRGS
	Conditions in the lake	JICA study results
	Water quality and bottom sediment quality of area in the lake.	ALM (Mirim Lake)
	Living organism	FZB, NGO
Generation per unit data (required water amount, sewage amount, generation load)	Domestic wastewater (water amount and water quality by type of use)	CORSAN, SANEP
	Industrial wastewater (water amount and water quality by type of industry	FEPAM
	Non-point source	None
Water quality standards	Environmental standards	SEMA
	Wastewater standards	SEMA
Development conservation plans (federal, state, and district levels)	Regional development plan (including urban planning)	SOPS
	Water resource development plan	DRM
	Natural resource protection plan	FEPAM, FZB
	Environmental facility construction plan (water supply, sewerage, solid waste disposal site)	CORSAN, SANEP
Research paper on every field		





THE STUDY ON THE ENVIRONMENTAL MANAGEMENT OF THE HYDROGRAPHIC BASIN OF PATOS AND MIRIM LAKES IN THE FEDERATIVE REPUBLIC OF BRAZIL	Fig. 11.-2
JAPAN INTERNATIONAL COOPERATION AGENCY KOKUSAI KOGYO CO., LTD. / PACIFIC CONSULTANTS INTERNATIONAL	Construction Process for Joint Use of Environmental Information and Data Base Management System

CHAPTER 12 ENVIRONMENTAL EDUCATION AND PERSONNEL CAPACITY BUILDING PLAN COMPONENT(8)

12.1 Basic Policies for Environmental Education

As repeatedly mentioned in Chapter 10, the cooperation and the participation of the residents are extremely essential to the implementation of the master plan components. In this regard, environmental education becomes a considerably important instrument. In the state of Rio Grande do Sul there are quite a number of educational texts that cover environmental problems in a unique manner. This study attempts to carry out a comprehensive environmental education program using these texts. Environmental education in the form of social education programs (excluding school education programs) was considered, and the basic policies below were established based on the experiences gained from the workshop held under this study.

(1) A division for popularization and awareness shall be established in FEPAM to promote environmental education as social education in cooperation with NGOs.

(2) The methods to be adopted for environmental education will focus on those that provide actual learning experiences such as site observations, monitoring, and cleansing work.

(3) The facilities, equipment and educational materials required for environmental education will be provided gradually.

(4) Environmental education will be planned in connection with schools and the NGO, and the study team will assist in the implementation.

12.2 Environmental Education Methods and Tools

The mass media would be an effective means of environmental education targeting an unspecified huge number of people. In this study, however, environmental education targeting a limited number of people was considered. For this type of environmental education the targets will be narrowed down in terms of area, employment, age and sex, and themes suitable to these will be selected and implemented according to the following methods.

(1) Creative activities (e.g. compositions, painting/drawing) interpreting special environmental problems.

(2) Workshop led by local administrators and NGO.

(3) Practical activities (e.g. cleansing and tree planting) for environmental improvement.

(4) Inspection of sites where environmental projects are being implemented.

(5) Debates/discussions on significant environmental problems in the area.

These environmental education activities will require a video tape, texts, leaflets, demonstration panels, video decks, TV, white board, and an OHP. These will all be installed at the base institution of the major municipality.

12.3 Basic Policies for Personnel Capacity Building

Along with the activities to promote environmental education, improving the skills of the state and municipal administrations in carrying direct conversations with the residents is also an important means of securing resident participation and cooperation. This will be carried out through training and the improvement of the following skills will be given emphasis in consideration of the nature of the environmental problem.

(1) Ability to understand the mechanism of an environmental ecosystem that surrounds human conditions as well.

(2) Ability to objectively assess and coordinate opinions of concerned parties with conflicting interests.

(3) Ability to comprehensively use knowledge and techniques in various related fields.

12.4 Personnel Capacity Building Methods

To improve the capabilities of the personnel of government agencies, training will be carried out and incentives will be provided, as shown below.

(1) On the Job Training

- Exchange of personnel between the state and municipal agencies, and temporary dispatch of personnel to international environmental agencies and international NGOs for training.
- Mutual exchange of knowledge and techniques within the place of work through research societies.
- Visits to problem sites and discussions with the residents at the site.

(2) Off the Job Training

- Participation in seminars and research associations covering particular environmental themes
- Acquisition of related qualifications

(3) Others

- Provide incentives such as recognition, promotion, and pay rise.
- Assignment to divisions and positions suitable to one’s capabilities

CHAPTER 13 PROJECT IMPLEMENTATION PLAN

13.1 Environmental Restoration and Conservation Plan for the Mar de Dentro Area

In accordance with the basic policies of the master plan components specified from Chapters 5 to 12, the program for the Environmental Restoration and Conservation Plan for the Mar de Dentro area was drawn as shown in **Table 13-1**. The program contains 12 sub-programs, each of which consists a selection of important projects and studies (including monitoring) on the restoration and preservation of the aquatic environment and wetland ecosystem (14 projects and 9 studies in total). The reason why there are quite a number of studies planned is because of the extensiveness of the target water area and basin, as well as the bad access conditions. On top of this, even with the combined results of this study and past studies, the environmental conditions in the target area are still not fully known.

The selected projects are what may be called as public works that will be implemented by the state and the municipalities within the limits of their respective budgets. None of these projects will involve investments from private corporations and landowners. For example, the “Cleaner Production Campaign” entails the study of economic measures that would provide private corporations with incentives, e.g. renewal of facilities, and the introduction of and extension of guidance in desirable production processes. Facility renewal, however, will be carried out by the corporation using its own funds. The “Promotion of an Environmental Conservation Oriented Agriculture” entails model project implementation and assessment and the preparation of optimum alternatives. The cost of the application will be the responsibility of the landowner.

13.2 Priority Projects

Of the projects outlined in **Table 13-1**, the “Cleaner Production Campaign” is very important to the Mar de Dentro area. The campaign however is considered effective if first implemented in the Guaiba River basin where many industrial point sources are situated. The training of government administrators would require that the state of Rio Grande do Sul first develop a standard training program that can be used for all state and municipal environmental administrators, and revise this to suit the Mar de Dentro

Table 13-1 Environmental Restoration & Conservation Program for the Mar de Dentro Area

Program	Sub-program	Project Outline (Target Area)	Description & Objectives
1. Point Source Load Reduction	**1.1 Domestic Load Reduction Measures**	**1.1.1 Construction of domestic wastewater collection and treatment system** (Pelotas, Rio Grande, Sao Lourenco do Sul, Tapes, Camaqua)	Prevent eutrophication in the southern water section and coliform contamination in the southern coast of the Patos Lake through the expansion of municipal sewerage network and construction of sewage treatment plant.
	1.2 Industrial Load Reduction Measures	**1.2.1 Strengthening of industrial wastewater monitoring activities**	Understand actual discharge of industrial load by creating an inventory on industrial generation sources. Reduce discharge load by establishing the allowable discharge load.
		1.2.2 Promotion of Cleaner Production program	Introduce desirable production processes by industrial type and extend guidance, to understand actual production processes. Study economic means that would act as incentives to improve production processes.
2. Non-point Source Load Reduction	**2.1 Urban Load Reduction Measures**	**2.1.1 Improvement of domestic solid waste collection and disposal system**. (Pelotas, Rio Grande, Sao Lourenco do Sul, Tapes, Camaqua)	Reduce litters that become non-point source load in urban areas by establishing a separate collection system, providing collection equipment, and construction a sanitary landfill site.
	2.2 Agricultural Load Reduction Measures	**2.2.1 Promotion Project of an environmental conservation oriented agriculture** (Cangucu area)	Establish an agricultural structure geared towards environmental conservation on a trial and error basis at the priority area, to determine the effective prevention of the runoff of soil and type of nutrients, as well as improvements in land productivity, in order to create a very suitable menu based on different conditions.
		2.2.2 Project for soil erosion and soil runoff prevention (Sutil and Duro rivers)	Carry out on a trial and error basis soil runoff prevention works e.g. afforestation/reforestation, in catchment areas considerably prone to soil runoff and the river, to create the best menu under different conditions.
3. Wetland Ecosystem Restoration & Conservation	**3.1 Education on the Functions of a Wetland Ecosystem**	**3.1.1 Awareness and expansion project on the functions of a wetland ecosystem**	Plan and implement activities, hands-on training, etc. effective in promoting understanding of the use of wetlands and the ecosystem, in concert with the wetland committee and NGO.
	3.2 Conservation of Wetlands	**3.2.1 Conservation of important wetlands** (Del Rey wetland, Camaqua riverine forest, San Goncalo canal, Pequena lake)	Wetlands that urgently need to be conserved will be registered under the Ramsar Convention, regulations will be developed and roads will be improved.
4. Establishment of a Hydrological and Water Quality Monitoring System P	**4.1 Establishment of a Monitoring System**	**4.1.1 Transfer of monitoring techniques**	Transfer of techniques to the municipality through the formulation of manuals on observation and sampling, as well as hands-on training.
		4.1.2 Monitoring facility expansion project	Increase data reliability to determine the effectiveness of monitoring work, by providing the equipment for the surveys and observation works, and constructing the facilities for analysis.

Program	Sub-program	Project Outline (Target Area)	Description & Objectives
5. Shared Use of Environmental Information	**5.1 Shared Use of Environmental Information**	**5.1.1 Construction of an environmental information database.**	Select database items, standardize format, and promote mapping information by GIS. The results will be published in the web site in cooperation with every sector concerned.
6. Environmental Education and Personnel Capacity Building	**6.1 Promotion of Environmental Education**	**6.1.1 Dissemination of environmental education activities**	Dissemination of environmental education activities by planning and holding workshops.
		6.1.2 Expansion of environmental education facilities	Promote environmental education dissemination activities by providing the necessary facilities, equipment, and educational texts.
	6.2 Personnel Capacity Building	**6.2.1 Training of local administrative personnel**	Train government employees to cope with activities requiring resident participation, by planning and holding a training program that aims to improve explanation skills and knowledge of the services.
7. Surveys and Monitoring	**7.1 Basic Surveys**	**7.1.1 Surveys on generation load per unit production**	Survey sewage discharge at the model area/plant, to determine domestic and industrial (main industries) per unit generation load.
		7.1.2 Surveys on actual contamination by agricultural chemicals	Analysis of agricultural chemical levels in bottom sediments and living organisms in the Patos Lake, to determine actual contamination by agricultural chemicals.
		7.1.3 Water quality monitoring of Patos Lake	Carry out monitoring works for a long term to grasp water quality fluctuation for the entire area of Patos Lake
		7.1.4 Water quality survey in the southern water section of Patos Lake	Carry out monitoring works that also include the coast and inlets, to accurately determine actual contamination in the southern area of the Patos Lake.
	7.2 Formulation of Plans	**7.2.1 Survey for the formulation of the Mirim Lake water quality control plan**	Analysis of runoff load in the entire Mirim Lake basin, including the section within Uruguay, in cooperation with the Mirim Lake committee for the formulation of the Mirim Lake basin water quality management plan.
		7.2.2 Survey for the formulation of the Camaqua River basin conservation plan	Formulate a basin conservation plan for the Camaqua River basin, to reduce soil and nutrient runoff into and in the river.
		7.2.3 Survey for the formulation of the Piratini River basin conservation plan	Formulate a basin conservation plan for the Piratini River basin, to reduce soil and nutrient runoff into and in the river.
7. Surveys and Monitoring	**7.2 Formulation of Plans**	**7.2.4 Survey for the formulation of the Guaiba River basin water quality management plan**	Review the sewage treatment and basin conservation plan of PRO-GUAIBA to formulate the N, P load reduction plan for Guaiba River basin, which is also considered to be very effective in preventing eutrophication in the Patos Lake.
		7.2.5 Survey for the formulation of the Leachate prevention at the existing disposal site in Rio Grande	Prevent contamination of surrounding water area by carrying out leachate prevention works at the existing disposal site.

Remarks: Gray column shows priority project and priority survey. Place names in parentheses show priority areas for project implementation.

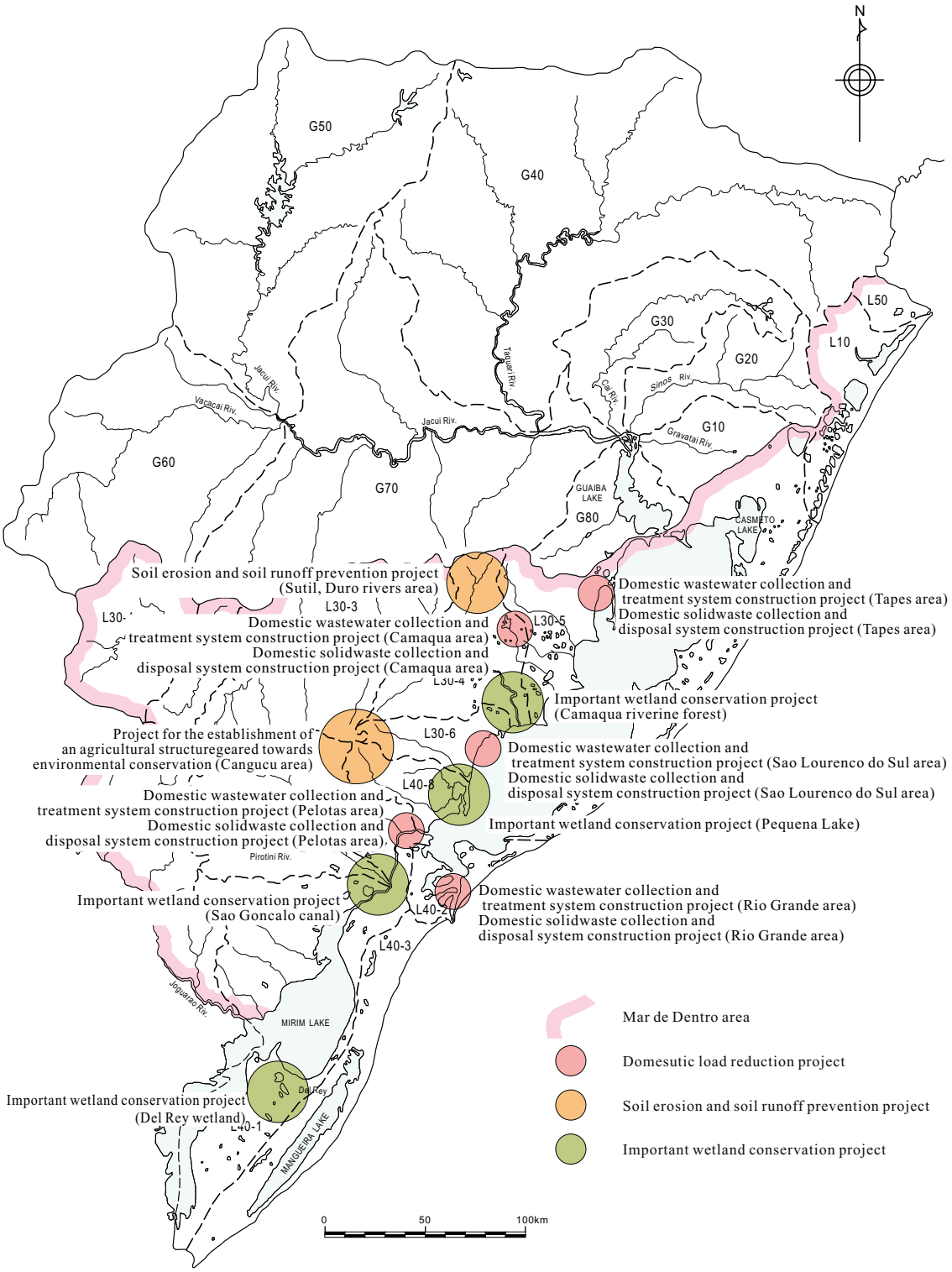
area.

Of the 9 studies, the study on generation load per unit production is a fundamental study that should be carried out at the federal level. Also the studies for the formulation of the water quality control plan for Mirim Lake basin as well as for Guaiba River basin are both extremely important to the preservation of the water quality of the southern section of Patos Lake. Since Mirim Lake is under the jurisdiction of the federal government and countermeasures for Guaba River are being implemented under the PRO-GUAIBA PROGRAM, these agencies then should be mainly responsible for the planning and implementation of the studies.

Accordingly, the number of projects to be given priority and to be implemented in the Mar de Dentro area total 12, of which 6 are studies. Areas that will have a great impact on the preservation of the Patos and Mirim lake water quality and the wetlands will be given priority in terms of project implementation. **Fig. 13-1** shows the areas prioritized for project implementation in parenthesis ( ).

13.3 Implementation Schedule

Projects that involve facility construction are generally implemented according to the following stages: preparatory stage, master plan study, feasibility study, fund procurement. Of the priority projects selected in the previous section, those that involve facility construction will commence from the feasibility study stage as the master plan is already covered under this study. An implementation schedule most suited to each priority project was studied in consideration of the time each study stage would require and the target year specified in Chapter 4 (see **Fig. 13-2**).



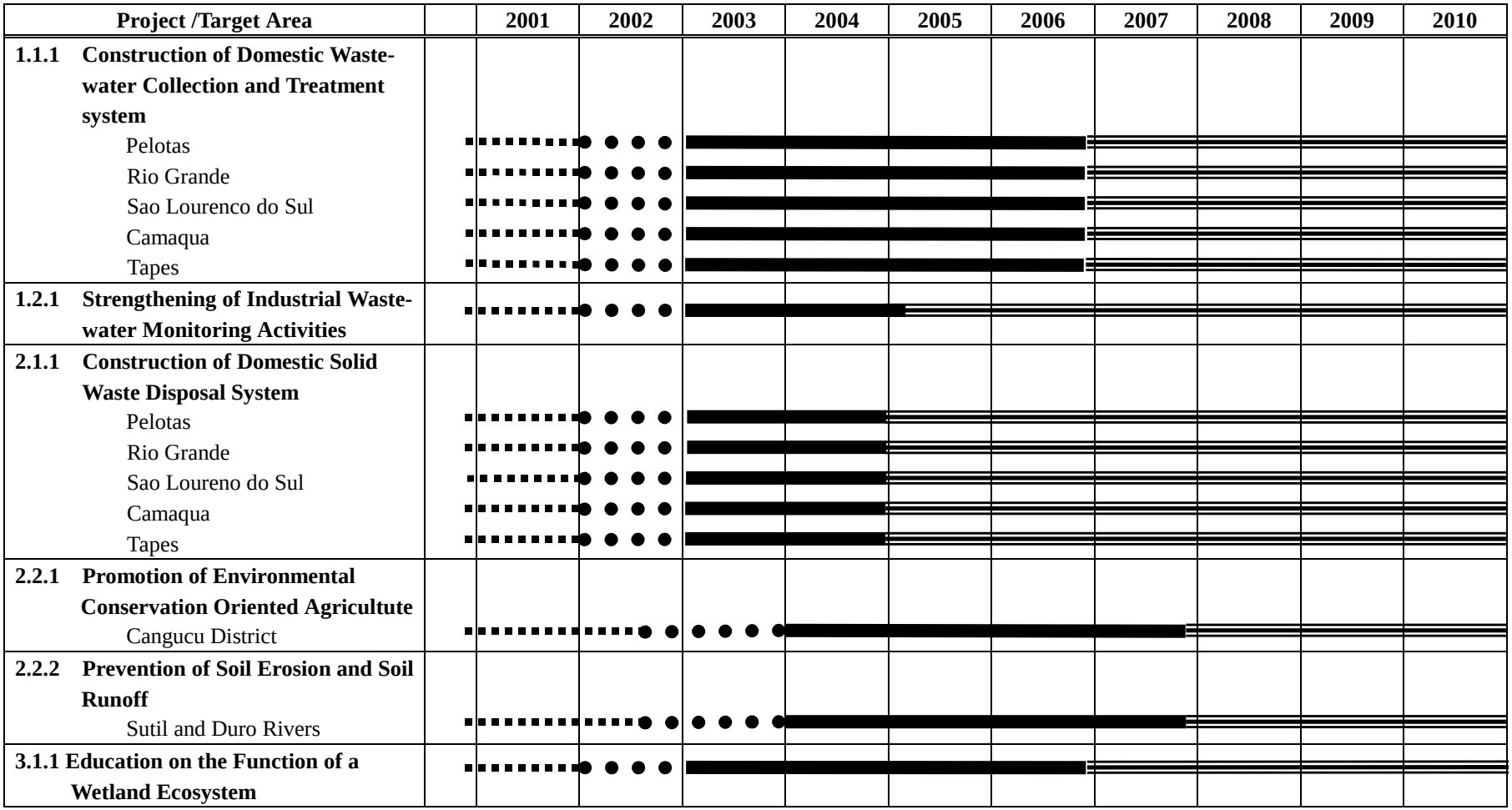
THE STUDY ON THE ENVIRONMENTAL MANAGEMENT OF THE HYDROGRAPHIC BASIN OF PATOS AND MIRIM LAKES IN THE FEDERATIVE REPUBLIC OF BRAZIL

JAPAN INTERNATIONAL COOPERATION AGENCY
KOKUSAI KOGYO CO., LTD. / PACIFIC CONSULTANTS INTERNATIONAL

Fig. 13-1

Implementation Area for the Project with Facilities

Fig. 13-2 Implementation Schedule of the Priority Projects and Investigations



Project /Target Area		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
3.2.1 Conservation of Wetlands											
Del Rei wetland											
Camaqua riverine forest											
Sao Goncalo Canal											
Pequena Lake											
4.1.1 Transfer of Monitoring Techniques											
4.1.2 Expansion of Monitoring Facility											
5.1.1 Construction of an Environmental Information Database											
6.1.1 Promotion of an Environmental Education Activities											
6.1.2 Expansion of Environmental Education Facilities											
7.1.2 Study on the Contamination by Agricultural Chemicals											
7.1.3 Water Quality Monitoring of Patos Lake											
7.1.4 Water Quality Survey for the Southern Water Section of P. Lake											
7.2.2 Study on the Integrated Management Plan of Camaqua											
7.2.3 Study on the Integrated Management Plan of Piratini											
7.2.5 Study on the Measures against Leachate in Rio Grande											

Study **Financial Preparation etc.** **Project Implementation (Land acquisition, Construction, Installation etc.)** **Operation & Maintenance**

13.4 Project Cost

The priority projects and the studies were classified into 7 categories and the expenses were roughly estimated (see **Table 13-2**). There is a need to estimate the project expenses through the feasibility study for a highly accurate estimation.

The required initial investment totals about US$66 million, and about 50% is appropriated for the sewage treatment project for 5 municipalities. Of these, 90% is allocated for the projects with facilities; those are the sewage treatment project, solid waste disposal project, basin conservation project, and wetland conservation project.

The annual operation and maintenance cost is estimated at about US$6.62 million – about 9% of the initial investment cost – if all priority projects and studies are implemented. About 50% of this cost is considered important for the operation and maintenance of the sewage treatment project, and the solid waste disposal project.

13.5 Fund Procurement Plan

In principle the state and municipal budget should be used to cover the project expenses. This study, however, assumes federal government subsidy for the sewage treatment project, which occupies a huge part of the initial investment, and the monitoring project.

As for the operation and maintenance expenses for the sewage treatment project and solid waste disposal project, it is desirable to be paid as tariff paid by the beneficiaries depending on the collected amount.

13.6 Disbursement Plan

The studies and site acquisition activities necessary for the implementation of the priority projects will be completed by 2002, and the year targeted for the completion of the other projects are as follows: 2006 for the sewage treatment project, 2004 for the solid waste disposal project, 2008 for the basin conservation project, 2004 for the wetland conservation project. The annual initial investment amount, operation and maintenance expenses, and the facility renewal expenses to complete the payments by 2033 were calculated (see **Table 13-3**).

Table 13-2 Cost of Priority Projects

Project & Investigation	Large Category	Initial Investment	Annual O/M Cost	Financial Source
1.1.1 Construction of Domestic Wastewater Collection and Treatment System	Sewage Treatment Project	30,470,000	2,468,000	(I) Municipality+Federal (OM) Municipality (Collection fee from users)
2.1.1 Construction of Domestic Solid Waste Collection and Disposal System	Solid Waste Disposal Project	8,792,730	2,200,000	(I) Municipaoity+State (OM) Municipality (Tax)
7.2.5 Investigation]on the Countermeasure for Leachate at Rio Grande Existing Solid Waste Disposal Site				
2.2.1 Introduction of Environmental Conservation Oriented Agriculture	Basin Conservation Project	12,040,000	496,000	(I) State+Land owner (OM) State+Land owner
2.2.2 Prevention of Soil Erosion and Soil Runoff				
7.2.2 Integrated Management Plan for Camaqua River Basin				
7.2.3 Integrated Management Plan for Piratini River Basin				
3.1.1 Education on the Function of Wetland Ecosystem	Wetland Conservation Project	13,262,000	948,600	(I) State (OM) State
3.2.1 Conservation of Wetland				
1.2.1 Strengthening of Monitoring for Industrial Wastewater	Monitoring Project	1,339,590	207,650	(I) Federal+State (OM) State+ Municipality
4.1.1 Technical Transfer of Monitoring Techniques				
4.1.2 Expansion of Monitoring Equipment				
7.1.2 Investigation on the Contamination by Agricultural Chemicals				
7.1.3 Water Quality Monitoring for the Whole Area of Patos Lake				
7.1.4 Water Quality Monitoring for Southern Area of Patos Lake				
5.1.1 Construction of Environental Information Data Base	Information Management Project	35,000	150,000	(I) State (OM) State
6.1.1 Promotion of Environmental Education Program	Environmental Education Project	92,650	150,000	(I)) State+Municipality (OM) State+Municipality
6.1.2 Preparation of Equipment for Environmental Education				
Total		66,031,970	6,620,250	

I: Initial Cost OM: Operation & Maintenance Cost

Table 13-3 Disbursement Schedule

Initial cost (US$ 1,000)

Year	Sewage Treatment	Solid waste	Basin Cons.	Wetland Conserv	Monitoring	Info. Manage.	Envir. Educat.	Sub-total
2002	470	457	340	3,230	372	35	93	4,997
2003	7,500	4,168	3,225	5,016	484			20,393
2004	7,500	4,168	2,425	5,016	484			19,593
2005	7,500		2,500					10,000
2006	7,500		2,500					10,000
2007			525					525
2008			525					525
Total	30,470	8,793	12,040	13,262	1,340	35	93	66,033

Source: Cost documents from corresponding experts in charge.

O.M. cost (US$ 1,000)

Year	Sewage Treatment	Solid waste	Basin Cons.	Wetland Conserv	Monitoring	Info. Manage.	Envir. Educat.	Sub-total
2002	0	0	0	0	0	0	0	0
2003	0	0	0	0	0	150	150	300.00
2004	0	2,200	60	450.0	0	150	150	3,010.00
2005	0	2,200	292	948.6	207.65	150	150	3,948.25
2006	0	2,200	368	948.6	207.65	150	150	4,024.25
2007	2,468	2,200	431	948.6	207.65	150	150	6,555.25
2008	2,468	2,200	447	948.6	207.65	150	150	6,571.25
2009	2,468	2,200	462	948.6	207.65	150	150	6,586.25
2010	2,468	2,200	462	948.6	207.65	150	150	6,586.25
2034	2,468	2,200	462	948.6	207.65	150	150	6,586.25
Total	69,104	68,200	13,610	28,908.0	6,229.50	4,800	4,800	19,5651.50

Source: Cost documents from corresponding experts in charge.

Replacement cost (US$ 1,000)

Year	Sewage Treatment	Solid waste	Basin Cons.	Wetland Conserv	Monitoring	Info. Manage.	Envir. Educat.	Sub-total
2013						17.5	46.5	64.00
2014	5,931.25	1151.5	400	1608.5	484			9575.25
2015	5,931.25							5931.25
2023						17.5	46.5	64.00
2024	5,931.25	1151.5	400	1608.5	484			9575.25
2025	5,931.25							5931.25
Total	23,725.00	2,303.0	800	3,217.0	968	35.0	93.0	31,141.00

Source: Cost documents from corresponding experts in charge.

CHAPTER 14 PROJECT EVALUATION

14.1 Economic Evaluation

The following were the conditions adopted for economic evaluation for the case stipulating the attainment of the targets specified in Chapter 4 through the implementation of the 7 priority projects summarized in the previous chapter.

(1) The project expenses will consist of the initial investment cost, operation and maintenance cost, and facility renewal cost outlined in **Table 13-3** for the 7 priority projects.

(2) The following items are the quantifiable direct benefits of the project:
① increase in marine resources, ② increase in visitors to resort by lake shore, ③ increase in revenues brought about by developments in eco-tourism, ④ increase in farmland revenues, ⑤ reduction of dredging expenses, ⑥ reduction of public health and sanitation expenses, ⑦ reduction of economic aid to fishermen.
As only direct benefits were evaluated, the specified number of benefits that the project may incur is small. Nonetheless, the project is also expected to bring about the following indirect benefits: increase in land value, activation of the regional economy, increase in employment.

(3) Of the direct benefits, ①, ② and ③ were estimated to become double 20 years after the project is completed at an annual increase rate of 5% by the consensus maximizing technique of multi-criteria method (the method for estimating benefits through the discussion among the representative agencies). Based on this assumption, the following were calculated: present annual output of marine products:15,000 tons (US$1,000/t), annual increase in visitors to lake shore resorts: 200,000 people (US$40/p), annual increase in participants of eco-tourism: 400,000 people (US$20/p).

(4) Of the direct benefits, the increase rates of ④, ⑤, ⑥, and ⑦ were respectively established at 3.5%, 1%, 2% and 2% using the method described in the preceding clause.

(5) From 2005, 2 years after the project has started, the benefits will be calculated until 2034, 30 years, as in the life span of civil structures.

The total amount of the benefits calculated within a 30 year period is US$953,250,000, 36% of which are considered to bring about increase in marine resources.

A cash flow showing the annual project expenses and project benefits was made to determine the IRR (Internal Rate of Return), B/C (benefits/cost), and NPV (net profit value). The calculation shows an IRR of 13.10%, B/C of 1.31, and NPV of US$31,735,700 (10% discount rate).

The results of the sensitivity analysis show a 10% increase in the project expenses and a 10% decrease in benefits in comparison with the standard case. Nonetheless the benefits still exceed the project expenses as the IRR, B/C, NPV were calculated at 10.80%, 1.07, US$8,262,810, respectively.

14.2 Technical Evaluation

Brazil and the state of Rio Grande do Sul have actual experience in the technologies (both hard and soft) necessary for the implementation of the projects proposed in the master plan, hence no problems are expected to arise in terms of safety, reliability, and feasibility. As for the sewage treatment plant (oxidation ditch + wetland) and the sanitary landfill site, however, sufficient research on relevant conditions internally and abroad should be carried out during the feasibility study, in order to create a design that suits prevailing conditions in the area, as neither of these facilities have ever been constructed in Mar de Dentro.

As a non point source countermeasure consisting both mechanical and agronomical methods, “environmental conservation oriented agriculture” should be popularized in the whole basin area. Although the former method is already being practiced by the farmers, the latter still has and needs to be developed with due consideration of the conditions suitable to the area and production efficiency. The cooperation of relevant agricultural agencies in the state is strongly expected for the implementation of this countermeasure.

14.3 Environmental Impact Assessment

Since the projects proposed in the master plan were devised in the aim to restore and conserve the aquatic environment and the wetland ecosystem, there is a need to mitigate

whatever adverse environmental impact they are expected to incur. However, for the sewage treatment project and solid waste disposal project for urban areas, localized adverse environmental impacts are likely if the management of the sewage treatment and solid waste disposal systems is inadequate, as these systems target to treat and dispose sewage and solid waste from numerous point sources at a designated area.

What is most feared that would result from the construction of the sewage treatment plant (oxidation ditch + wetland) proposed in the master plan is the generation of foul odor and insects. Accordingly, considerations should not only focus on the location of the facilities, but also the regular pump inspection, cleaning of wetlands, and cutting down of dead vegetation.

It is also highly likely that a waste disposal site would generate foul odor, leachate and litter, cause fire outbreaks, and breed large numbers of rodents, birds and insects, and is therefore feared to ruin the scenery. The development is also considered to bring about noise and dust from the waste collection vehicles and the landfill equipment.

The master plan proposes the installation of gas removal and leachate treatment facilities in the landfill site. Although it is possible to control the adverse impacts to a minimum by selecting the site for the construction properly, appropriate implementation and management of construction work, it would also be necessary to plant trees outside the landfill site to act as a buffer zone and the frequent application of cover soil and spraying of insecticide.

14.4 Overall Evaluation

From the results of the aforementioned economic, technical and environmental evaluation activities, it is concluded that the implementation of the proposed master plan would be of considerably importance.

CHAPTER 15 RECOMMENDATIONS AND SUGGESTIONS

(1) The master plan for water quality control in the Patos and Mirim lake area was formulated under this study, and mainly entails the strengthening of water quality monitoring activities and wetland preservation to attain the specified goals. The water quality control plan was originally intended to be formulated parallel with the water area/wetland/basin use plan and the regional economy development plan. None of these plans, however, have taken shape in the Mar de Dentro area. The state of Rio Grande do Sul should, as soon as possible, formulate a development plan in harmony with the master plan proposed herein in accordance with the basic policies of the Mar de Dentro Program, which was implemented to develop the characteristics and potential of the area in order to increase the income of and create job opportunities for the residents. The water quality standards, allowable inflow load and target reduction load stipulated in the master plan will be the criteria used to determine the scale and contents of the development plan.

(2) As over 80% of the inflow load in the Patos and Mirim lakes originates from non-point sources, a long term basin conservation measure for a vast area should be taken; the cooperation of the landowners is indispensable to the implementation of these measures. Under the traditional land ownership system in the state of Rio Grande do Sul, many areas are careless with the use of the land and landowners are really not that concerned about developing an environmental conservation oriented agriculture and soil erosion and runoff prevention measures. But for the implementation of non-point source countermeasures landowners should be made to understand that these will improve land productivity in the long run, and their cooperation in the implementation of the measures should be acquired

(3) The actual production activities and wastewater and solid waste management conditions in the industrial point sources in the Mar de Dentro area are hardly determined. The industrial production output of the Mar de Dentro area is only about 1/10 of the entire state. In Rio Grande, there are large scale factories, therefore, wastewater is estimated to have quite an impact on the surrounding water area. Based on this, the actual production activities and wastewater and solid waste management conditions in the industrial point sources will be determined, and monitoring will be carried out to determine the water quality in surrounding

water areas.

(4) In the master plan, the concept adopted for the sewage treatment plan for Pelotas and Rio Grande and the solid waste management plan for Pelotas is very basic. To come up with concrete schemes, the implementation of a feasibility study is required. For the municipalities that were not covered, the state government is expected to formulate a basic plan using this master plan as a reference.

(5) The runoff load from the Guaiba River basin makes up about 60% of the Patos Lake inflow load, and this is particularly evident in the northern half of the lake where eutrophication is reaching a critical level. At present, the runoff load from Guaiba River basin does not impact the southern water section. However, it is forecast to affect the area in the future and immediately raise the level of eutrophication as a result. Although this underscores the extreme importance of reducing nutrient salt loads in the Guaiba River basin, this is not covered at all in the PRO-GUAIBA Program. In the future, it is necessary to incorporate into the PRO-GUAIBA Program sewage treatment and basin conservation measures that would affect nutrient salt reduction.

(6) For the implementation of the master plan proposed herein, the following should be simultaneously carried out: organizational strengthening, fund procurement, continuous studies and monitoring activities, effective use of available data, educational activities for the residents. The state of Rio Grande do Sul should hasten the implementation of the policies proposed in the master plan based on the experiences gained from the preceding PRO-GUAIBA Program. In addition, the state should also expedite the strengthening of the planning and coordinating functions of SEPMD, the executing secretariat for the Mar de Dentro Program.

(7) The socio-economic conditions in the basin are subject to changes every year – changes that are immediately reflected in the conditions of the water areas and the wetlands. The results of calculations using the runoff load simulation model, the hydraulic and water quality simulation model developed in this study, and the water quality monitoring results should be compared incessantly, to clearly identify the reasons for the changes in lake water quality and to establish more effective countermeasures.